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A STUDY OF MANAGEMENT INFORMATION SYSTEM NEEDS FOR THE ELECTROM--ETC(U)

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**A Study of Management Information System  
Needs for the Electromagnetic Compatibility  
Laboratory of the Naval Air Test Center**

GERALD A. WILSON

*Computer Science Laboratory  
Communications Sciences Division*

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May 1978



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aircraft. The other MIS would support the data base of reported EMC/EMI problems from operational equipment as a part of NATC's role as lead laboratory for aircraft EMC. Several potentially useful systems are reviewed, and the criteria for selecting an appropriate MIS system are discussed.

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A STUDY OF MANAGEMENT INFORMATION SYSTEM NEEDS FOR THE  
ELECTROMAGNETIC COMPATIBILITY LABORATORY OF THE  
NAVAL AIR TEST CENTER

1. Introduction

The problems of electromagnetic compatibility (EMC) and electromagnetic interference (EMI) are beginning to receive considerable attention in the Navy as aircraft and ships are increasingly dependent on complex collections of electronic equipment. As the use of electronic equipment has grown, it has become necessary to test and evaluate all the electronic equipment used in aircraft, and to track reported problems relating to EMC/EMI potential sources. Organizations such as the Electromagnetic Compatibility Laboratory of the Naval Air Test Center must not only test specific aircraft and their components for EMC and EMI problems, but also keep accurate records of the characteristics and reported problems for hundreds of pieces of equipment. With the combination of this expanded data base of information and cutbacks in personnel, NATC found it prudent and necessary to investigate tools, such as management information systems, which would help in the management of their growing EMC/EMI data base. This is the final report of an investigation, performed for NATC by the Naval Research Laboratory (NRL), of the requirements and utility of management information systems to support the EMC/EMI effort.

The two-fold purpose of this investigation was to determine those aspects of the work performed by the EMC lab of NATC which might benefit from the support of a management information system, and to recommend the most cost-effective manner for installing such a system. It was determined that there are two distinct, though closely related, needs for management information which exist in the EMC laboratory of NATC. The first requirement is a system to manage a data base of aircraft equipment and component specifications. This would be used by the engineers and technicians performing EMC/EMI testing and evaluation of aircraft. The second requirement is a management information system to maintain and generate necessary reports about



EMC/EMI problems and related information as reported from operational Navy and other sources.

In order to support the equipment and component specification data bases it is recommended that any readily available general purpose commercial data management system be employed. The choice of the specific system should be determined primarily by the availability of actively supported software on the NATC in-house computers or computers readily available to NATC at reasonable cost. It is not expected that this data base will be widely used outside of NATC, but NATC may be able to draw, in part, on existing aircraft equipment data bases from systems such as the Intrasytem Electromagnetic Compatibility Analysis Program (IEMCAP)[5].

For the management of the EMC/EMI problem data base more specialized tools are required than those embodied in standard data management systems. A number of available systems were examined and, of these, two appear to be leaders for NATC's needs: AMPCS and AWCAP. Each system has both advantages and drawbacks for NATC, and they must be evaluated more closely as NATC develops a more comprehensive understanding of its requirements relative to the EMC/EMI problem data base. It is also possible that another management information system not discovered and evaluated in this study might prove to be best suited to NATC's requirements. One overbearing and, we believe essential, requirement for any selected management information system is that it be at least compatible with, if not identical to, the major systems of this type now in use in other parts of the Navy. The reasons for this strong recommendation are two fold. First, EMC/EMI problems pervade much of the operational equipment malfunctions in all types of Navy equipment. Therefore it is essential that information be readily sharable amongst the many data bases and many installations responsible for different types of Navy equipment. Second, the proliferation of similar but distinct management information systems makes both information exchange and system support difficult and costly. While this is a general problem which must be solved at a much higher level of authority than NATC, it is important that NATC not contribute to the problem by selecting and supporting yet another distinct management information system.

The information and analysis supporting these recommendations is presented below. Section two of this report addresses the functions and needs of the EMC lab. Section three provides a summary of the characteristics, strengths, and weaknesses of the existing management information systems which were examined. Our approach was to investigate only systems currently in use in the military, as the cost of building, or acquiring and maintaining, a new military and/or commercial system would be prohibitive. The recommendations to NATC are given in the final section of the report.

## 2. Functional Analysis of the EMC Laboratory

The responsibilities of the EMC lab fall into two general areas, management and testing. Although there is a considerable degree of overlap between the two areas, each is sufficiently distinct to merit independent consideration. In this section a brief description is given of the broad functional characteristics of each area, and each is analyzed with respect to information processing needs.

### 2.1 Management Functions

Two areas of EMC task management must be considered. The first of these is that resulting directly from the EMC lab's primary function of testing. As each piece of equipment, system, and aircraft is tested for EMC/EMI problems, new information is gathered about the undesirable interactions and/or potential interactions between equipments or systems. Beyond its immediate value in understanding and correcting current problems, this information may be useful in re-evaluating the aircraft if and when modifications are made, and also in helping to track down problems reported during operational use of the aircraft. Therefore it is important to be able to maintain and selectively retrieve the information gathered during the testing of each aircraft, system, and piece of equipment.

The second area of EMC task management is that of serving as the EMC/EMI lead laboratory. This effort requires the collection and progress monitoring of all suspected EMC/EMI problems experienced by operational Naval aircraft. For each reported operational aircraft problem which is suspected to be EMC/EMI in nature, NATC must maintain full records. Included in these records is a description of the malfunctioning equipment, the nature of the malfunction, the diagnosis of the problem, the equipment sources and victims, the anticipated impact of the problem, the method for correcting or avoiding the problem, and the current status of the problem and necessary corrective action. Depending on the situation, it may be necessary to search this collection of data for specific types of problems, certain equipment, distinct victims or sources, general classes of problems, particular problems relating to given military specifications, etc. In addition it is necessary for the Lead Lab to track each problem from the initial report, through the steps of diagnosis, development of the fix, testing of the fix, and finally to the implementation of the fix in the operational aircraft. Tracking must include both



updating of the data base as each stage is completed, and prompting the responsible organizations when unexpected or unexplained delays occur in any stage.

## 2.2 Testing Functions

The primary purpose of the EMC lab is the testing and evaluation of new or modified aircraft in order to verify and spot check the EMC/EMI characteristics claimed by the aircraft manufacturer and/or specific equipment suppliers. Because it is neither technologically nor economically feasible to fully test all of the equipment and systems on any given aircraft under all conceivable operating conditions, most of the testing must be done on the bench, in a hanger, or only by theoretical examination. Thus the test engineers must rely almost exclusively on a combination of manufacturers specifications, military specification standards, past experience, and theoretical knowledge. The general approach employed is as follows:

- (a) Develop a two dimensional matrix of all the equipment and systems of the aircraft under test. Each entry in the matrix will represent the actual or potential interference between two items of the equipment and system list.
- (b) Using the manufacturers' specifications, military specifications, and any other appropriate information, determine the expected degree of interference for each element of the matrix not on the main diagonal. When specific pieces of equipment and/or their specifications are not available, the corresponding rows and columns of the test matrix are ignored.
- (c) If sufficient time and funding is available, some of the elements of the matrix which indicate a high potential for interference between equipments can be further investigated by actual testing of the equipment on the bench or in the subject aircraft.
- (d) The final results are compiled and a report written.

Two types of aid could be provided to the engineers and technicians performing these EMC/EMI tests. As described, most of the testing is performed by hand collection and examination of the data, rather than actual testing of the physical equipment. To reduce this to a manageable problem, the NATC engineers have resorted to examining

only interactions between pairs of equipments or systems. They also employ many heuristics (most of these being informally specified "standard practice" or "hunches"), based on both formal training and past experience, to enable them to examine only a relatively small portion of the characteristics of each piece of equipment or system. This process could be greatly facilitated and the depth of the examination improved if appropriate computer aids were available. Two such aids would be simulation facilities and systems modelling/analysis facilities. Simulation is a process that employs computer models of some of the properties of a piece of equipment or system in an attempt to mimic the performance of the equipment or system under a variety of conditions. Simulation can be used to advantage where the corresponding tests with the actual equipment would be too time consuming or too expensive, and also where the necessary test conditions would be very difficult and expensive to accomplish. Thus the in-flight performance of equipment can be examined by simulation more economically and more safely than under actual flight conditions. Systems modelling/analysis is a process in which mathematical models describing the expected performance of the equipment or systems are analyzed to determine predictions of unusual or interesting conditions, such as conditions of expected EMI. An example of a computer aid for this purpose is the Intrasytem Electromagnetic Compatibility Analysis Program (IEMCAP) facility developed by McDonald Douglas Corporation. This system can provide automated analysis of the aircraft components based on mathematical models of electronic component behaviour. Such a computer aid can provide detailed suggestions of expected interference under specific conditions, and would enable many more situations to be examined than could be accomplished by hand.

As neither simulation nor systems modelling/analysis facilities are management information systems, they will not be discussed further in this report. However, it should be noted that both such computer aids are often complemented and enhanced by a management information system which can aid the engineer in storing and retrieving the data required for simulation or systems modelling/analysis studies.

The second type of computer aid which would directly benefit the testing process would be a data management or management information system. Such a system would provide the capability for storing and maintaining a data base of equipment and system characteristics, for editing and expanding that data base, and for generating reports about all or a portion of that data base. An engineer developing or implementing a test plan could request all the known information about specific equipment, all of the equipment with given specific characteristics, a history of EMC/EMI problems with certain equipment, a list of EMC/EMI problems of a certain type for any class of equipment, etc. Thus much if not all of the information which must now be tediously prepared by hand for each aircraft tested might be provided by a brief session with the management information system.

### 3. A Brief Survey of Some Management Information Systems

From the discussion in section two of this report it is clear that there are two distinct, though closely related, needs for management information which exist in the EMC laboratory of NATC. The first requirement is a system to manage a data base of aircraft equipment and component specifications. This would be used by the engineers and technicians performing EMC/EMI testing and evaluation of aircraft. The second requirement is a management information system to maintain and generate necessary reports about EMC/EMI problems and related information as reported from operational Navy and other sources. These two requirements necessitate data bases and information management system functions sufficiently diverse to force each to be treated independently. The primary reasons for considering the two requirements separately are as follows:

- (a) The EMC/EMI problem data base is expected to be updated, extended, and selectively edited quite frequently, and thus it is a potentially very dynamic type of data base. But the equipment data base will change more slowly because new equipment is added and old equipment modified or deleted on a relatively infrequent basis.
- (b) The EMC/EMI problem data base will tend to have a large proportion of the information in a relatively free form paraphrasing of the description and analysis of the reported problem. Thus experts will have to examine each new item for the data base to extract key words and phrases on which to index the elements of the data base to enable retrieval of the information. The equipment data base will tend to have a small collection of well defined engineering oriented attributes to be stored for each item, and thus entry, editing, and storing of the data will be well specified beforehand and easily accomplished with sophisticated hand analysis and encoding of the information.
- (c) The EMC/EMI problem data base will require many reports to be produced for both operational and management personnel in order to keep them informed about existing and suspected equipment problems. Thus reports must be formatted and constructed in a manner appropriate for such computer unsophisticated users. But the equipment data bases will be used to generate either reports for engineers doing testing, or machine readable data bases for other systems such as IEMCAP. In this case quite different formats, ones intended for reference by engineering and technical experts, will be required.



Many factors must be considered in determining the "best" system for managing the data base of EMC/EMI problems. The major factors are as follows:

- (a) Data encoding and indexing -- Reports about EMC/EMI problems will come from many diverse sources in both operational and testing facilities. As such they will tend to use a diverse set of terms, special phrases, and perhaps poorly phrased descriptions of the problems. Therefore it is essential that each report be examined by experts who will index it, employ consistent terminology, check for potential errors, and properly format the information. All of the systems described in section three use humans as a part of the management information system support team to perform this function. Not even state-of-the-art computer systems and software techniques are sufficiently powerful to perform this task in a completely automatic fashion. It is also not advisable to allow the report originators to attempt to index the report and utilize only common terminology, as they normally are conversant with only a small portion of the data base and often have personal biases which might distort the indexing or paraphrasing.
- (b) Turn-around-time -- In a system in which all inputs, including corrections and updates, must go through a central control point, the time it takes to process the initial request and actually update the data base, called here the turn-around time, can be quite long. If the users can directly update the data base from online terminals, a great deal of time and paperwork might be saved. However, the on-line system often may not include the mechanisms for carefully checking the new data to assure that updates are correct in both content and format. Without such checking there is always the risk of propagating erroneous information through the data base.
- (c) Local vrs. Network Access -- There are only two reasons for employing a management information system attached to a computer network. The first is that the system of choice is on a distant computer which is attached to a network. The second is that there are multiple locations at which data is to be entered or information searches are to be performed, and that the most economic means to enable access to the management information system from all the desired locations is to employ a computer on a network. If neither of these situations is true, then the system chosen should either be on local computers, or on a distant computer utilized by means of fixed leased lines or dial-up long distance lines. The reason for this is that both the initial cost and

maintenance costs of becoming a node of a network or creating a new network are high. The benefits must therefore be commensurate with the costs.

- (d) Support Personnel -- Any management information system requires personnel to maintain the software. In this case it is also necessary to have knowledgeable personnel to maintain and update the data base, as the originators of the information will not enter or update information in the data base directly. All the systems described in section three require special personnel to examine, correct, standardize, index, and maintain all the data supplied by the users. This is a feasible and economically viable approach if the data base is sufficiently large and is updated frequently. However, for a small data base, or a large one with only a small volume of updates, a dedicated special support group would generally not be justifiable. But another important factor which can increase the utility of either outside or internal support is the ability to share support personnel with other tasks. Any time the cost of support personnel can be shared over a number of projects so that no one user or management information system is realizing a disproportionate portion of the total support cost, the cost of maintaining each system or data base is usually reduced. However this dilution of the support group may also make the group less responsive to and knowledgeable about any single user or data base being supported. Thus the trade-off between a dedicated support group and one shared with others must be made based on both cost and the level of support required. Once the expected size and update volume for the EMC/EMI problem data base is determined, NATC must decide who shall provide the support personnel and in what manner.
- (e) Specific Needs -- While many different types of services can be provided by each of the systems described in section three, the decision about which system is best must take into account the relative importance of each possible service. For example if the reports required can be prepared with a sufficiently high quality of printing by use of photo-offset printing from line printer copy, then the advantages of a system such as AWCAP or DCAP where on-line type setting is used to produce reports are small. The relative importance of each of the capabilities provided by a system can only be determined by NATC.
- (f) Expected Costs -- The costs of utilizing any of the systems discussed in section three is highly dependent on the size of the data base, the volume of updating, the volume of searches, and the number and type of reports produced. Once



these factors have been determined by NATC within reasonable error bounds, the relative monetary cost of providing the required data base capabilities with each automated system versus a manual system can be evaluated. While it is certainly not true that the automated systems costs must be lower than corresponding manual processing costs, the relative difference should still be examined. If all the required functions could be handled on a timely basis with a significantly lower overall cost by a manual system, then an automated system is unnecessary. If however the monetary cost of an automated system appears viable, then the additional non-monetary factors such as personnel availability, preparation for future growth, timeliness of reports and information handling, and ease of use can be taken into account.

- (g) Miscellaneous Factors -- Some other less complex factors must also be taken into account. The computer which would service the desired management information system must not be overloaded with the proposed additional usage. Neither the computer nor the management information system selected should be scheduled to lose support and be phased out in the near future. Any terminals, key punches, or other equipment required to utilize the selected system must be available and affordable within the expected budgetary constraints. Because the initial cost of creating or obtaining a data base and an associated management system is usually high relative to its yearly maintenance cost, it must be assured that we are not creating a "white elephant" for which neither NATC nor any other organization will have any use in a short time.

New data base management and management information systems are developed and implemented in both the commercial and military markets frequently. However it is virtually an impossible task to track down and obtain documentation for each of the available systems. The approach employed for this study was to drastically narrow the search process by making the following assumptions:

- (a) In order to determine the long term benefits and requirements for an EMC/EMI management information system it is essential that the EMC lab have some direct "hands on" experience with employing potential systems. Thus a management information system must be obtained to allow the application of the "fly before buy" principle.
- (b) NATC has very limited funds to devote to the initial acquisition/development of a management information system for the EMC laboratory. Thus both new development and purchase-for-modification of commercial systems is out of the

question. Also eliminated are any systems requiring significant modification before use.

- (c) Candidate systems should be reasonably machine independent (i.e. independent of particular facilities or characteristics of certain computer system hardware or operating system software). This will enable an existing candidate system to be moved from the host computer where it is now available, to another computer of NATC's choice if this becomes necessary or desirable due to accessibility, cost, or security reasons. In addition, if at a later time it becomes appropriate for NATC to modify or tailor an existing management information system to obtain greater capabilities, the cost of moving the system to another computer, to prevent interruption of service to other non-NATC users, would be greatly reduced.
- (d) Strong consideration must be given to ensuring that any system chosen will be compatible with existing Navy management information systems with which NATC may need to exchange data. If at all possible the system chosen should be one currently existing within the Navy. This is not an attempt to standardize, but rather one to avoid the proliferation of essentially functionally equivalent systems with similar but distinct data representations. Such a proliferation only adds to the costs of exchanging data between systems.
- (e) The specific data items maintained in current data bases are of interest only as an indication of the system capabilities. Such systems can easily adapt to new data bases with little or no reprogramming. Therefore little effort was devoted in this study to understanding or evaluating the multitude of existing data bases available via the systems described below.

In the discussions of the systems presented below no attempt was made to provide a comprehensive evaluation of all aspects of any system. Funding and time limitations did not permit this, nor did it permit on-site observation of any of the systems. The systems described below are a representative sample of those management information systems available within DoD, and thus at no cost to the Navy. A more extensive list, but with less comprehensive information, of data base and management information systems is included in a report by Connor and Harvey[3].

### 3.1 Aviation Maintenance Plan Computer Support (AMPCS) System

In a report written by the Naval Aviation Integrated Logistic Support Center (NAILSC) for the Naval Air Systems Command (NAVAIR-411) in August of 1975[7] it was recommended that several existing systems for maintaining data bases of Unsatisfactory Material/Condition Reports (UR's) be combined into a single, potentially Navy wide, system. The existing systems were the S-3A UR-EI system of NATC, the ASMRA (Adjustment of Scheduled Maintenance Requirements through Analysis) system of NAILSC, and the CURES (Computerized Unsatisfactory Report Engineering Support) system of the Naval Weapons Engineering Support Activity (NWESA). The efforts which have been made since that report have resulted in a combined system called the Aviation Maintenance Plan Computer Support (AMPCS) system.

The AMPCS system is both a management information system and a management analysis system. It provides basic capabilities for maintaining data bases of equipment, equipment repair records, unsatisfactory report records, and planned maintenance schedules. It does not provide for maintaining files of equipment characteristics required for EMC/EMI testing and analysis. From the point of view of management analysis, AMPCS offers packages of programs for:

- (a) Scheduled Removal Component (SRC) maintenance;
- (b) Frequency Approach to Scheduled Maintenance Planning Techniques (FREQ);
- (c) Equipment Condition Analysis (ECA);
- (d) Equipment Cross Indexing Program (ECIP);
- (e) Computerized Unsatisfactory Report Engineering System (CURES);
- (f) Level of Repair (LOR) analysis; and
- (g) Engineering Change Proposal (ECP) cost analysis.

Additional details of the capabilities and uses of these analysis packages can be found in the AMPCS Users' Guide[1].

AMPCS is a "batch" mode system i.e. each user job is submitted to the computer as an actual or pseudo (typed on a terminal rather than a keypunch) card deck which must wait its turn to be executed, and the results are returned in the form of a complete printout at the conclusion of the processing of the job. There is an attempt to assure that no job waits longer than 24 hours for completion. Data storage costs are minimized by maintaining all of the data bases on magnetic tape rather than on-line bulk storage. To facilitate use by many geographically dispersed facilities, remote batch entry terminals



are supported along with appropriate toll-free WATS telephone lines for computer access. As shown in Figure 1 (taken from the AMPCS Users' Guide) there are currently 11 remote sites, two additional planned remote sites, and the main NAILSC site. These remote sites are supported by two computer sites: the San Antonio Data Services Center (SADSC) and the Applied Physics Laboratory (APL) of Johns Hopkins University.

Also shown in Figure 1 are the major sources of data currently available to AMPCS users. These are the Maintenance and Material Management (3-M), the Quality Deficiency Reports (QDR), the Engineering Investigation Requests (EI), Unsatisfactory Material/Condition Report (UR), the Safety Reports (SR), the Flight File (aircraft readiness and utilization information), VO11 (an aviation maintenance, event oriented master file from NAILSC), and the Depot Data Collection System (DMDCS) data bases.

The format, update, and general control of these data bases is handled entirely by the combined efforts of NAILSC and NWESA. This provides users with a central control point to assure a reasonable measure of error control for the data bases. However, it also means that any new data bases require support from one of these two organizations. This generally makes the cost prohibitive for a small, infrequently used, or narrow interest, data base.

The documentation provided in the AMPCS Users' Guide, available from either NAILSC or NWESA, is comprehensive and generally well written.

### 3.2 Airborne Weapons Corrective Action Program (AWCAP)

Although originally developed as a report generation facility, the AWCAP system has many features of a management information system. There are five objectives of the AWCAP system[2]:

- (a) Provide a central agency for processing, acknowledging, and reporting in-service problems/deficiencies of airborne weapons and target systems.
- (b) Make available communication channels to expedite the flow of problems and corrective action progress information.
- (c) Provide frequently updated information on the status of in-service engineering problems and follow-up action.

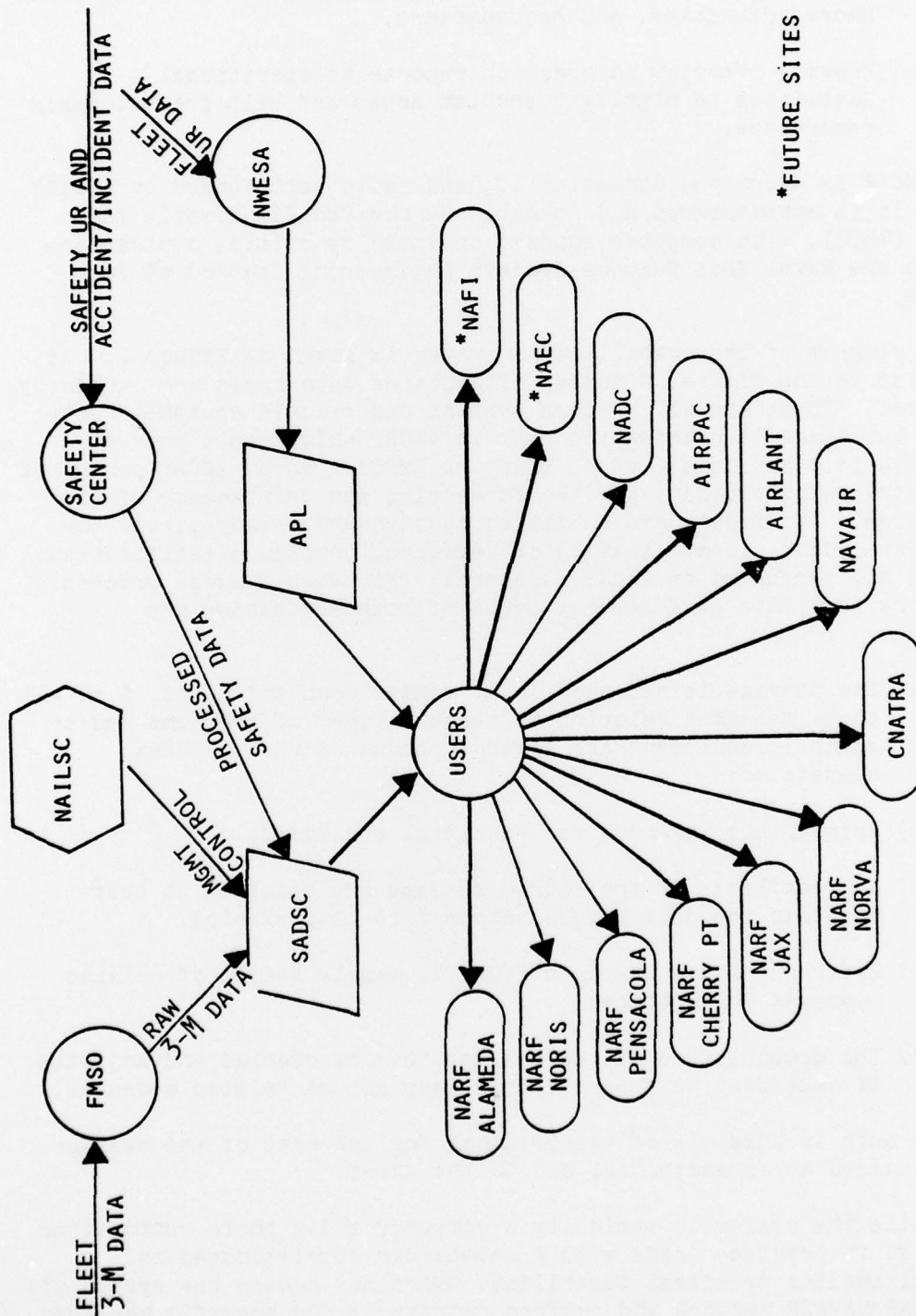


Fig. 1 - AMPPCS system computer network



- (d) Provide periodic information reports to operational commands, shore activities, and headquarters.
- (e) Provide overview information reports to operational activities to highlight problem areas and help prevent their recurrence.

AWCAP is under the direction of, and is in part funded by NAVAIR 4104. It is administered and operated by the Pacific Missile Test Center (PMTTC), with computer support provided by outside contractors through the Naval Ship Weapons Systems Engineering Station at Port Hueneme.

A diagram of the overall AWCAP system is given in Figure 2. As indicated in the figure, a number of distinct data bases are currently supported. These are all weapons systems and related equipment data bases, but there is nothing inherent in AWCAP which would prevent expansion to other data bases. Like the AMPCS system, AWCAP personnel hold total responsibility for the formatting and maintenance of the data bases. All inputs are submitted by standard messages, and the necessary coding, identification of keywords, problem classification, etc. is all performed by AWCAP personnel. For each message processed for entry in a data base several types of standardization are provided:

- (a) The message is assigned to a "common problem" class, i.e. all those messages relating to certain types of problems and/or specific equipment are given a common retrieval index classifier;
- (b) Appropriate keywords for retrieval are added;
- (c) Any conflicts in the source message are resolved to help maintain the data base as error free as possible;
- (d) Reference lists are maintained to enable series of related messages to be traced;
- (e) The nomenclature of the message text is checked and adjusted if necessary to assure consistency across related messages.

As much as possible of the original English text of the message is maintained as an additional aid to the users.

While the system is basically a computer aided photo composition facility, it provides users with a relatively sophisticated and powerful on-line retrieval capability. Users may access the system via the AWCAP/NAVAIR network and perform retrievals for specific messages or groups of messages, messages about a particular problem, or key

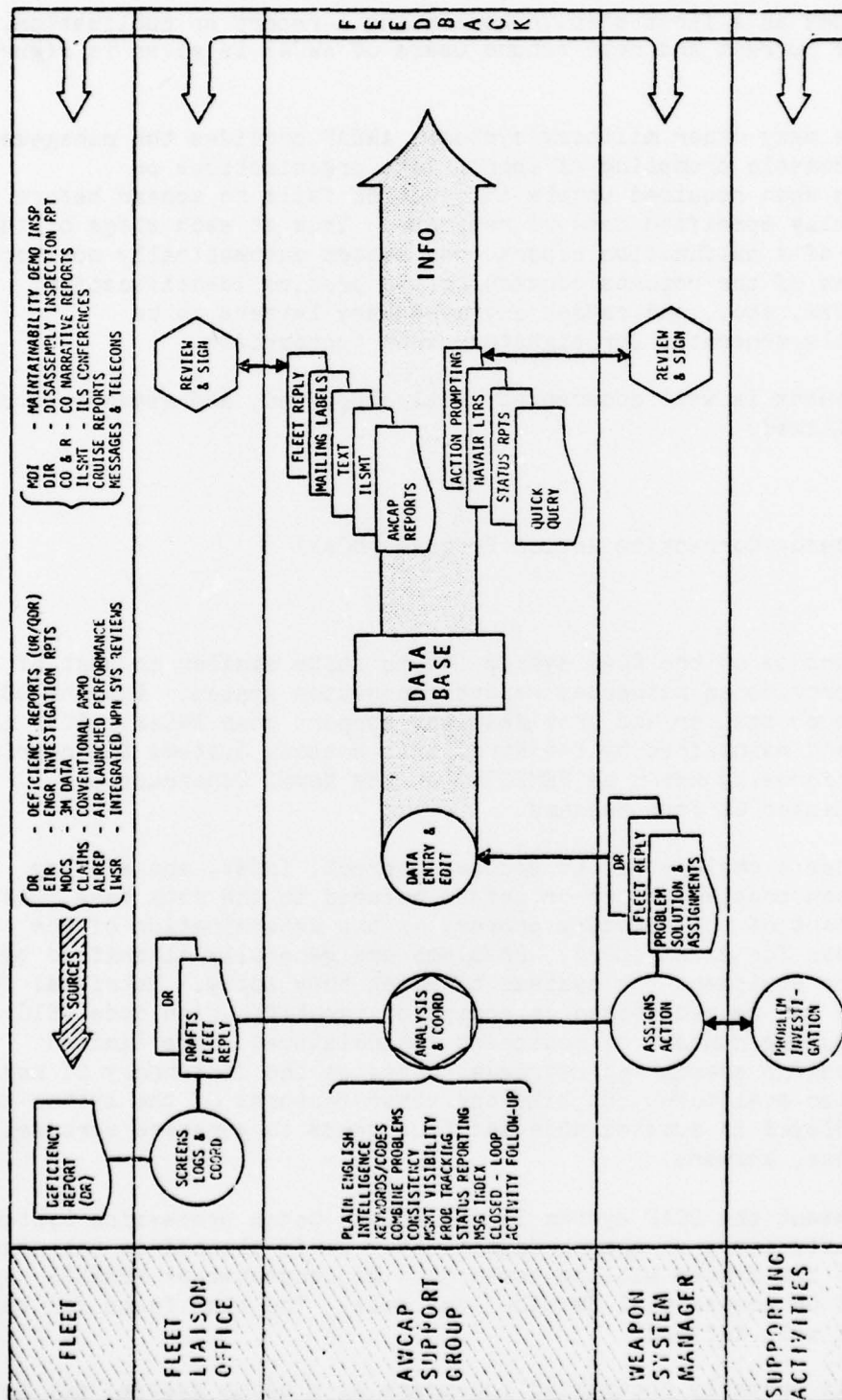


Fig. 2 - AWCAP system description

word searches as a first step in generating a report or publication. The list of current and near future users of AWCAP is given in Figure 3.

Unlike many other military systems, AWCAP provides the management tool of automatic prompting of appropriate organizations or individuals when required update information fails to appear before the originally specified date of response. Thus at each stage of the processing of a malfunction report, the system automatically monitors the progress of the reports concerning the problem identification, solution, fix, etc., and causes any necessary letters to be automatically generated for signature when appropriate.

The system is well documented, well supported, and appears to be heavily utilized.

### 3.3 Deficiency Corrective Action Program (DCAP)

The purpose of the DCAP system [4] is quite similar to that of AWCAP: to provide an automated report generation system. But the DCAP effort is much smaller and provides less support than AWCAP. DCAP is supported and maintained by the Naval Ship Weapons Systems Engineering Station (informally known as NEMESIS) at the Naval Construction Battalion Center at Port Hueneme.

DCAP has a small staff to encode, correct, index, and add key words to each problem report or update entered in the data base. As in AWCAP, part of the encoding process is the determination of the problem class for each report. Problems are generally classified by the specific equipment for systems to which they apply. Retrieval of information can be made based on equipment identification code (EIC), problem sequence number, or equipment nomenclature. Some limited capabilities for search and retrieval based on the dictionary of key words is also available, but like the other features of the system can only be employed in a batch mode and thus tends to generate verbose, slow response, answers.

At present the DCAP system is strictly a batch processing system with no remote entry or search capability. It is planned in the near future that the system will be moved to a minicomputer at NEMESIS, and remote dial up access will be made available. The time frame for this move is not well defined.

DCAP is properly documented for users as a batch system, but no



PRESENT USERS	PRESENT SYSTEMS	RECENT ADDITIONS
NAVAIR ARLINGTON, VA PMTC PT. MUGU, CA NAFI INDIANAPOLIS, IN NAD MCLESTER, OK FLTAC CORONA, CA MARTIN ORLANDO, FL MAC DAC ST. LOUIS, MO ROCKWELL COLUMBUS, OH NAVFAC ALEXANDRIA, VA CHESDIV WASHINGTON, D.C. NORTHDIV PHILADELPHIA, PA SOUTHDIV CHARLESTON, S.C. LANTDIV NORFOLK, VA WESTDIV SAN BRUNO, CA	AIRCREW ESCAPE PROPULSION AIR COMBAT MANEUVERING RANGE BOMBS BOMB DUMMY UNITS BULLPUP CONSTRUCTION SPECIFICATIONS CONVERSION TARGETS EA-6B SOFTWARE F-14 SOFTWARE F-14 WEAPONRY GUNS & AMMO HARPOON PHOENIX RANGES (ITCS, FTRCIS) ROCKETS SPARROW SIDEWINDER SHRIKE STANDARD ARM TOW TARGETS TARGETS AQM/BQM/MQM WALLEYE FMS IMPERIAL IRANIAN AIR FORCE	F-14 AVIONICS HARPOON (D-CAP) F-18 NUCLEAR WEAPONS  Future Systems Tomhawk

Fig. 3 - AWCAP (MARS) systems/services applications

documentation is yet available for a remote time shared or remote batch version of the system.

### 3.4 MATCALS Document Control Register System

As a part of the overall MATCALS effort the Naval Electronic Systems Command had a software system built to facilitate the storage and retrieval of information provided by experts concerning any of the MATCALS issues. Although it has many of the features of a management information system, the MATCALS Document Control Register (DCR) system is somewhat more oriented towards document retrieval than management information. The primary distinction to be made is that a management information system has the ability to reorganize and extract only the relevant information from the data base to create a report, while a document retrieval system simply returns the documents, or pointers to the documents, which might be relevant (i.e. contain the required answers).

As illustrated in Figure 4 from the MATCALS Document Control Register System Final Report[6], the DCR system is designed to maintain an indexed library of comments, short notes, and technical papers appropriate for the given subject category. Reports generated by the system consist of lists of titles, or titles plus text, of all the documents from the library which have index keys relevant to the question asked by the user. All of the indexing is performed by hand through the combined efforts of the originators of the documents and the subject experts of the DCR personnel. Questions to the system must be stated in terms of valid key-words.

MATCALS DCR system is available for on-line update, entry, and search by means of the INFONET network. All of the software has been developed using the General Purpose Programming Subsystem (GPS) and the Data Management Language (DML) of INFONET, and is thus quite dependent on the services of Computer Sciences Corporation. The DCR system appears to be well documented and its designers, Tracor Sciences and Systems, claim it could be modified reasonably easily to expand its capabilities. However, it is clear that any such modification would be heavily dependent on Tracor if it is to be economically accomplished.

### 3.5 Shipboard Electromagnetic Compatibility Improvement Program



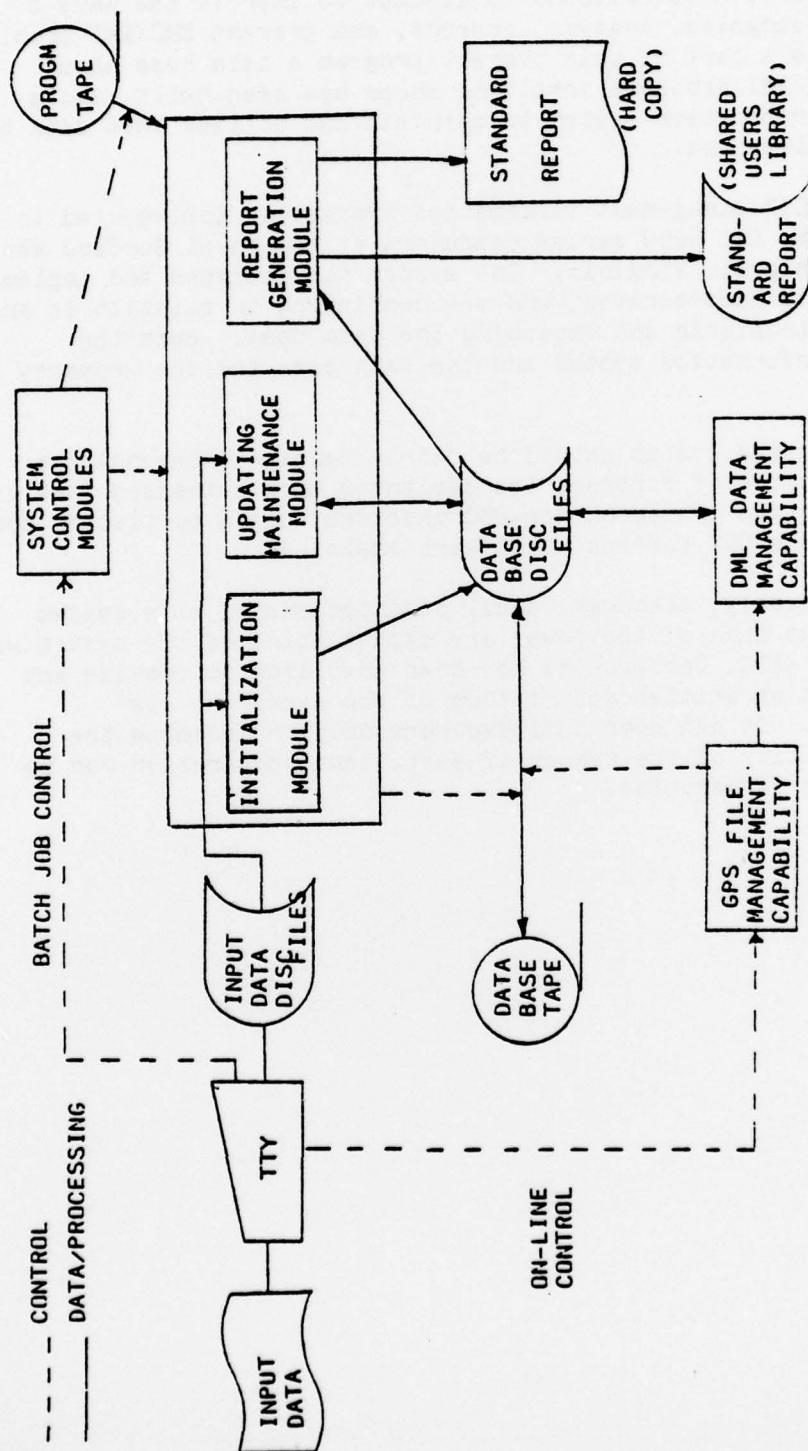


Fig. 4 - DCR program description

Under the direction of the Naval Sea Systems Command, NAVSEA 06T, a program has been established to attempt to improve the Navy's ability to recognize, analyze, correct, and prevent EMC/EMI problems on ships. As a part of this overall program a data base about reported EMC/EMI problems involving ships has been built, and a management information system to maintain and utilize that data base has been implemented.

The SEMCIP management information system was implemented in Fortran on the CDC 6000 series computers at the Naval Surface Weapons Center at Dahlgren, Virginia. The system was designed and implemented by Cerberonics Incorporated, who are continuing to maintain it and assist in maintaining and expanding the data base. Both the management information system and the data base are the property of the Navy.

Although the system should be fairly machine independent by nature of the use of Fortran, its designers have expressed some doubts about running the system on non-CDC machines due to particular special features of the CDC Fortran which were employed.

Unfortunately, although verbal descriptions of this system indicated that much of the power and capabilities of the system would be of use to NATC, Cerberonics has been unwilling to provide any documentation or written description of the system or its capabilities. It has been included here only to indicate the potential utility of the system if sufficient cooperation can be obtained from Cerberonics.

#### 4. Summary and Recommendations

None of the systems described in section three appear directly applicable to the requirements for maintaining an equipment data base. They do not provide for the maintenance of data bases with a highly structured format as that envisioned for the equipment data base. They also do not enable the generation of reports formatted in a manner appropriate for machine readable data such as that required for IEMCAP.

For the equipment data base two alternatives are available:

- (1) Utilize the minimal data base creation, editing, and reporting capabilities incorporated into the IEMCAP system;
- (1) Utilize whatever commercial general purpose data management system is available as a part of the new computer facilities being procured for NATC;

The first alternative has the advantage that the same data bases are being used both for an inventory of equipment specifications and for input to the analysis capabilities of IEMCAP. Thus no additional effort would be required to build or modify the data bases. This alternative has the disadvantage that IEMCAP has only limited data base editing and reporting facilities, it has no available indexed retrieval mechanism for searching and retrieving information, and the users would be limited to exactly the type and content of the information used by IEMCAP.

The second alternative would provide much more flexibility with respect to the information stored in the data base, the search and retrieval capabilities, and the types of reports produced. However it will require new data bases to be created and may also require an additional, though probably simple, computer program to reformat machine readable output intended for use as input to IEMCAP. The problem of creating new data bases might be eased considerably by converting existing IEMCAP data bases by means of a special computer program to reformat a machine readable IEMCAP data base into the required equipment data base system input format. Note that in such a case any updates to the data base after the initial conversion would be required separately for both IEMCAP and the equipment data bases unless some direct cooperative arrangement for utilizing a single data base for both systems were established. However this approach would provide NATC with a large collection of machine readable data bases on aircraft and aircraft systems in a short time for a relatively small cost.



The final decision about the best approach to select will require more detailed analysis once both IEMCAP and NATC's new computer facilities are available to the EMC lab.

All of the factors discussed in section three must be examined carefully before the method for supporting the EMC/EMI problem data base is selected. Using this approach two of the five systems discussed in section three appear to be somewhat better for NATC's needs than the other three. AWCAP appears to have the most complete collection of reporting mechanisms of all the systems examined, but also has the potential disadvantages of being physically located on the west coast and of being intended as an automated report generation system rather than a management information system. AMPCS appears to have most of the features of AWCAP for maintenance of the data, and is physically convenient to the EMC Lab. The potential disadvantages of AMPCS are that it is a batch system and that its report generation capabilities are not as complete as the EMC Lab would ultimately require. However, it is imprudent and premature for any specific management information system to be recommended for selection at this time, both because the conditions and constraints of NATC's task and needs are not yet completely defined, and because the capabilities, costs, and relative merits of the management information systems described in section three and others not described are not fully known. In addition to NATC's needs and requirements changing, each of the available systems is under development and enhancement almost continuously. However, the guidelines described above should enable the required decisions to be made at the appropriate time.

One important factor mentioned earlier which must be emphasized is the relationship of any management information system selected for use by NATC to other such systems in the Navy. There is a strong need for consolidation and, to that extent, standardization of management information systems used by the Navy. The differences among the systems reviewed in section three do not appear to be very substantial, and yet each is sufficiently distinct to prevent a free interchange of data between different data bases on different systems. Because no single data base contains all the information about all the components of a single type of aircraft as it is operationally configured, it appears likely that EMC/EMI testing and problem identification and correction may require access to multiple data bases. Yet the proliferation of distinct management information systems with distinct data base formats has made these desirable interchanges of information difficult if not virtually impossible. NATC will not solve this problem; it is a Navy wide problem requiring solution at much higher levels of authority. However, it is strongly recommended that NATC not contribute to the problem by establishing yet another management information system with yet another data base format, capabilities, and software engineering design. Even if the "best" system available in the Navy lacks some facility or feature

desired by NATC but not vital, it would be best to persevere using an existing acceptable system without the desired capability and hope that the gentle pressure of the user community will eventually force the desired capability to be made available. Bringing in a new system with the desired capability would solve NATC's short term problem at the expense of aggravating the long term Navy wide problem and probably also NATC's problems.

## 5.0 References

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